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(54) **WIND TURBINE SYSTEM**

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US-A- 4 457 666 US-A- 5 380 149

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to improved vertical-axis wind turbines with enhanced conversion of wind kinetic energy into mechanical energy. Vertical-axis turbines are typically of a long axis type, allowing large columns of air to be harnessed. These devices differ from horizontal-axis (propeller) type windmills which typically pivot about a vertical axis in order that they may face directly into a wind. The improvement of the invention comprises the use of lightweight materials for the construction of the components of the wind turbine. The vertical-axis turbines of this invention are designed to be employed as a cost effective alternate power source in any wind condition.

BACKGROUND OF THE INVENTION

[0002] Wind as a source of energy is a concept that has been promoted for some time. According to one source, there is evidence which shows that windmills were in use in Babylon and in China as early as 2000 B.C. The United States Patent and Trademark Office has granted patents on windmill devices dating back to the early to mid 1800's. Despite the continued research and development in this age old technology, until the present invention, no windmill or wind turbine device has successfully appropriately addressed some of the most important problems which have seemingly made the harnessing of wind not economically feasible. While wind is unquestionably a large potential source of energy, estimated to be about 5 kW per acre in the United States, its variability in velocity has made it an unreliable source. Many devices such as U.S. Patent Nos. 4850792 to Yeoman, 4035658 to Diggs and 2406268 to Terhune have relied on the ability of concentrating low to moderate winds for producing power. Others, like those shown in U.S. Patent Nos. 4834610 to Bond and 4075500 to Oman, et al. (a horizontal-axis turbine), have accomplished the harnessing variable wind speeds by using modem variable speed governors. No device currently known to the present inventors is capable of adequately harnessing low and high-winds for power production. High winds are characterized, for purposes of discussion as currents having average velocities above 20 m/s (45 m.p.h.), or having gusts greater than 27 m/s (60 m.p.h.) Many devices are designed to fold and/or feather in winds reaching certain levels. Such devices are illustrated in U.S. Patent is Nos. 4818181 to Kodric, 4632637 to Traudt, and 3942909 to Yengst. These techniques, while intended to protect the structural integrity of the windmill, decrease a device's ability to produce power. Others, such as Patent No. 5,391,926 to Staley and Elder, attempt to harness high winds emanating from any direction for power production but low to moderate winds have been unable to produce adequate torque for continual

reliable power generation. Until the present invention variable winds have been an untapped source of energy by those skilled in the relevant art.

[0003] DE-A-3828361 describes a rotor having four or more fixed and as many movable rotor blades which are positioned vertically and rotate about the vertical axis. The movable rotor blades are curved in a circular shape.

[0004] US 5,380,149 discloses a wind turbine cross wind machine which comprises a specified circumferential arrangement of guide vanes around a centrally located rotor. The rotor blades have a curved profile shape.

[0005] In the past, wind driven power generators of all sorts have attempted to harness the energy present in the wind. Some have concentrated their efforts in the low to moderate wind range and suffer periodic damage from the occasional high wind while others work well in the moderate to high wind range with little or no success in harnessing low speed wind. No prior art has effectively drawn useable power from the slight breeze all the way to gale force winds. Perhaps one of the biggest reasons for the lack of all wind turbines has to do with the structural integrity of typical wind devices. By design many are lightweight, inadequately supported, and made from insufficient materials. A number of these devices are comprised of a multitude of moving parts, such as rotors, stators, vanes, shields, and the like. These parts not only compromise the integrity of the machine, but also require continuous maintenance, repair and/or replacement. For such a device, which may produce only a few kilowatts of power, the costs soon begin to outweigh the benefits. Another concept widely used is to build large multi-story wind turbines capable of producing at or near the megawatt level. Two such devices are shown in U.S. Patent Nos. 3902072 to Quinn, and 3994621 to Bogie. It is believed that these devices would cost close to \$100 million to build and several hundred thousand to maintain each year. Another example is the 1.25 MW generator installed near Rutland, Vermont. This is believed to be the largest windmill ever built in the United States, having two main blades each 53 m (175 feet) in diameter. This facility operated intermittently between 1941 and 1945, during the war years when most resources were being used for war efforts. In 1945 one of the blades broke due to material fatigue and was never repaired, presumably due to a lack of cost efficiency. Similar to the smaller units, these large devices become cost prohibitive on a much larger scale. The present invention solves this second problem by presenting a low cost, low maintenance, cost efficient wind turbine. While certain aspects of the design have been known, until the present invention the proper combination of elements, new and old, has not been achieved to provide a commercially viable product.

[0006] Variable wind velocity is not, of course, the only obstacle in harnessing kinetic energy from the wind. Wind direction has been another area of study and development. Wind currents are typically unpredictable, and due to topography, upper air disturbances, changing weather patterns, or seasonal variations, they rarely blow in the

same direction for any substantial length of time. For this reason effective wind machines must be capable of immediately accommodating winds from a full 360 degrees. Some devices have attempted to accomplish this goal with pivoting shields, and stators or wind directing vanes. U.S. Patent Nos. 4474529 to Kinsey, 537494 to Stevens et al., the Yengst patent, and many other devices illustrate such an approach. As mentioned previously, additional moving parts usually detract from a machine's cost effectiveness. While not in the field of the present invention horizontal-axis machines typically pivot the entire rotor assembly so that it may face upwind. Still other designs leave the rotor assembly open (that is, no wind directing vanes or stators are utilized) so that winds from any horizontal direction may impart rotation upon the rotor assembly. This leaves the rotor completely open to the harshness and destructive abilities of the wind. Once again the present invention solves this problem by providing 360 degrees of wind reception, in all types of wind conditions.

[0007] One important application of a wind turbine able to respond to wind from all directions and of variable velocity is as a power generator on top of tall buildings. One reason for this is that wind velocity typically increases with altitude above the ground. For example, the wind velocity at the top of a 36 story building is on average 8 m/s (18 mph) faster than on the ground, and is typically 20 m/s (45 mph) faster at the top of a 70 story building. As another example, the wind velocity at the top of the Sears Tower in Chicago, Illinois, averages 31 m/s (70 mph). This wind at the tops of tall buildings is clearly a potential power source. A wind turbine large enough to be economically useful on top of a tall building would measure about 6 m (20 feet) tall by 6 m (20 feet) wide. A wind turbine of this size built out of traditional materials such as 0.0127 m (1/2 inch) thick steel plates would weigh about 127×10^2 kg (28,000 pounds) and additional bracing required to hold the turbine in place would weigh as much as 272×10^2 (60,000 pounds). A problem with a turbine of this size is that it would be unresponsive to light wind as it would require a wind velocity of at least 8 m/s (18 mph) before it would begin to turn. There is also a gyroscopic effect associated with the turbine as it begins to rotate that increases with increasing rotational speed that would cause additional stress to the building in response to the torque on the turbine. In addition, traditional materials such as steel, due to its thermal conductivity, would begin to form ice on the turbine blades, which would negatively impact the smooth flow of wind through the turbine.

[0008] The present invention, in its various embodiments, recognizes and addresses these and other problems and overcomes many limitations encountered by those skilled in the art. Many devices and procedures have taught the use of folding or feathering in high wind conditions, and thus have been unable to realize the potential power of high winds. Others, such as the Staley and Elder patent have attempted to address the damag-

ing characteristics of high winds by stressing structural integrity and durability to the point of sacrificing the ability to produce adequate torque in the low to moderate wind speed range. It is not economically feasible to build a wind turbine that can only produce mechanical power during periods of high wind. The entire range of wind conditions must be fully utilized for a wind turbine to be commercially viable. Problems such as high cost and high maintenance of most wind energy facilities exist in the field, but such problems have not been adequately addressed by those skilled in the art. While high velocity wind is a well known natural occurrence with high kinetic energy, its value in the field of vertical-axis wind turbines has not only been ignored to some extent, it has often been looked upon as a detriment. The prior art has taught away from the present invention by stressing rotor attachment and stator curvature. Rather than supplying a system which affords only an incremental increase in performance over the prior art, the present invention utilizes techniques which were not previously considered in order to achieve what may perhaps be leaps in performance compared to the prior art. Further, the present invention has achieved a more full utilization of a previously untapped precious natural resource, the wind.

SUMMARY OF INVENTION

[0009] The present invention relates to a wind turbine according to claim 1. Further embodiments of the invention are defined in Claims 2 to 15.

[0010] The present invention discloses an improved wind turbine which provides enhanced conversion of wind kinetic energy into mechanical energy and which operates in all wind conditions, such as velocities up to 58 m/s (130 mph) and frequently changing wind directions. The improvement comprises the use of light weight modern building materials such as lightweight composite laminates to reduce the weight of the wind turbine and the improved thermal properties of such materials decrease the tendency of turbine blades to form ice. Non-metallic materials such as fiberglass or carbon fiber composite materials are as strong as steel but with only a fraction of the weight. The preferred materials are honeycomb sandwich panels that typically feature a honeycomb core manufactured from an aramid fiber with various non-metallic face layers, such as epoxy, fiberglass, phenols, and kevlar. Alternatively, lightweight metals such as aluminum can be used in the construction of the honeycomb core. The face layers can be laminated.

[0011] The wind turbine also provides a reliable and effective means for directing air currents into and out of the rotor cage assembly. Rather than supplying a system which affords only an incremental increase in performance and design over the prior art, the present invention utilizes combinations and techniques which were not previously considered to achieve an increase in performance unparalleled by the prior art. This invention serves to operate with a minimum number of movable parts and

systems, to optimize potential power production by allowing energy from high winds to be harnessed as well as low and moderate winds, and to optimize air current intake and exhaust by providing immediate accommodations to winds from any given direction.

[0012] In general terms, the invention involves various embodiments of a vertical-axis wind turbine. Many of the elements of this device achieve several different objectives which, when combined, act to achieve the mentioned increases in performance. In the preferred embodiment, the invention discloses stationary stators for more effectively directing currents into the rotor cage assembly to impart a higher rotational velocity and greater torque upon the turbine shaft through some torque generating elements such as the rotor blades. In addition, the stationary stators provide a structural integrity necessary for operation during high wind conditions. This aspect also prevents the disruption of rotation by shielding the rotors from winds counter-directional to their rotation which may occur as the wind shifts. The present wind turbines comprise stator blades which are straight and wherein the stator blades are offset by optimal offset angle so that there is a minimal effect on the loss of wind kinetic energy.

[0013] Importantly, the invention breaks from several time honored traditions in harnessing wind. By recognizing and utilizing the potential energy of all winds, and by designing an apparatus with resistance to the destructiveness of these winds during standard operation the present invention achieves its goals.

[0014] Accordingly, the present invention provides an omni-wind, vertical-axis turbine which can be employed in many different environments including on the tops of tall buildings. The stated invention acts to convert wind currents into mechanical energy which energy may then be transferred from a turbine or the like to be used to directly act upon a water pump, or to drive an electrical generator (or more generically an energy-utilizing device) for use as an alternate power source. The turbine may be equipped with any number of rotors and stators which interact with the variable wind currents during operation. In addition, a minimum number of moving parts is used to increase reliability, to decrease maintenance, and to decrease production costs.

[0015] It is an object of the present invention to provide a wind turbine design and construction which is capable of operation with enhanced efficiency in a variety of wind conditions. Such conditions include, but are not limited to, winds from any direction which possess a horizontal component, even where such wind direction is capable of frequent changes, winds reaching velocities of 58 m/s (130 m.p.h) or more, and winds with continuously changing velocities. It is an object that the present invention be capable of standard operation during these conditions without any need for employing folding and feathering techniques, or a speed control or braking system.

[0016] It is another object of the present invention to provide an improved design which is capable of immediately accommodating winds from any direction having

a horizontal component, as stated earlier. It is an object that this immediate readiness of the present invention be achievable with no moving parts.

[0017] It is, therefore, an object of the present invention to provide a design which utilizes a minimum of moving parts for improved reliability. It is an object that necessary maintenance and replacement of any parts should be minimized, and the durability of the entire apparatus be vastly improved. Furthermore, an object of this invention is to provide an improved wind turbine which can be used in various environments including tall buildings and which the turbine elements which resist icings.

15 BRIEF DESCRIPTION OF DRAWINGS

[0018]

20 Figure 1 is a perspective view of an embodiment of the invention from the side.

Figure 1A is a perspective of the new invention from the top.

25 Figure 2 is a view of the rotor cage from the side.

Figure 2A is a conceptual drawing of the rotor cage assembly from the side.

30 Figure 3 is a perspective view of the rotor cage from the top showing the alignment of the rotor blades.

Figure 4 is a view of the stator blades from the side.

35 Figure 4A is a conceptual drawing of the stator blades from the side.

Figure 4B is a top view of the stator blades showing their alignment.

40 Figure 5 shows the stator cage cover which allows the invention to be "topless".

45 Figure 6 is a view of the top shield from the side.

Figure 7 is a perspective view of the top shield from above.

50 Figure 8A is a cut-away view of a typical honeycomb panel used in the

manufacture of the invention, depicting a hexagonal cell.

55 Figure 8B is a cut-away view of a typical honeycomb panel used in the manufacture of the invention, depicting a rectangular cell.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] The following descriptions and referenced drawings are for selected preferred embodiments of the present invention. Naturally, changes may be made to the disclosed embodiments while still falling within the scope and spirit of the present invention and the patent granted to its inventor.

[0020] The improvement of the invention comprises the use of lightweight materials which allow the enhanced conversion of wind kinetic energy into mechanical energy in the construction the components of a wind turbine. Such a construction is particularly important for embodiments intended for use on top of buildings. Non-metallic materials such as fiberglass or carbon fiber composite materials are as strong as steel but with only a fraction of the weight. The preferred materials are honeycomb sandwich panels such as, for example, those manufactured by the Euro-Composites® Group, depicted in Figures 8A and 8B. These panels typically feature a honeycomb core manufactured from an aramid fiber with various non-metallic face layers, such as epoxy, fiberglass, phenols, and kevlar. As can be seen from the figures, the cells of the honeycomb core extend perpendicular to the face layers of the panels. One type of honeycomb core features a hexagonal cell, depicted as (20) in Figure 8A, while Figure 8B depicts another type of honeycomb core utilizing a rectangular cell (21). The face layers (22) are typically laminated. Details about these materials can be found at the Euro-Composites® Group web site, euro-composites.com, the contents of which are incorporated herein by reference. Non-metallic carbon-fibers are the preferred construction materials, but as an alternative, a lightweight metal such as aluminum can be used in the manufacture of the honeycomb core.

[0021] As discussed above, a 6 m (20 foot) by 6 m (20 foot) turbine manufactured with 0.0127 m (1/2 inch) steel panels would weigh about 127×10^2 kg (28,000 pounds) and would need additional bracing. An equivalent sized turbine manufactured from 0.019 m (3/4) to 0.072 m (7/8 inch) thick carbon fiber laminate panels would weigh only about 454 kg (1,000 pounds) and would need no additional bracing. A turbine this light would be able to begin rotating in a wind velocity of only 2.2 m/s (5 mph,) as apposed to the 8 m/s (18 mph) required for the steel embodiment, and can rotate at a much higher angular velocity than the steel embodiment. A turbine having components made from the honeycomb sandwich panels can produce power in both lighter breezes and heavier winds than the steel embodiment. The light weight of the honeycomb sandwich panel turbine also reduces the additional stress placed on a building by the gyroscopic effects of the rotating turbine. In addition, the honeycomb sandwich panel turbine embodiment is more efficient than the steel turbine embodiment. For example, tests performed on a turbine that is 0.61 m (2 foot) high by 1.22 m (4 feet) in diameter indicate that a steel turbine

operates at an efficiency of about 20.3%, that is, it converts about 20.3% of the wind kinetic energy into usable energy, such as electrical power. A fiberglass turbine of the same size operates at about 25.1% efficiency, and a turbine manufactured using honeycomb sandwich panels produced by the Euro-Composites® Group operate at about 32.3% efficiency. Unlike steel turbines, turbines manufactured from honeycomb sandwich panels become more efficient as the size of the turbine is increased, and efficiencies of up to 45% are possible. The honeycomb sandwich panel materials also have a much lower coefficient of thermal conductivity than metals such as steel, and thus will not form ice under normal operating conditions.

[0022] As can be seen from the drawings, the basic concepts of the present invention may be embodied in many different ways. Figure 1 and 1A show the preferred embodiment of the wind turbine (8) having a shaft (1) that is turned by rotor blades (2) that are attached to a top rotor cage plate (3) and bottom rotor cage plate (4) then drive an energy-transfer element (11) and an energy-utilizing device (12) (both shown as contained within or at the base). The height of these rotor blades in one of the preferred embodiments is 1.42 m (4 feet 8 inches) but will vary proportionally with the size of the unit built. In another preferred embodiment intended for use on top of tall buildings, the rotor blades are at least 6 m (20 feet) high by 6 m (20) (feet) in diameter. Furthermore, in accordance with preferred embodiments of the present invention, from 2 to 5 blade elements may be used. Wind is compressed and directed to the rotor blades (2) by numerous stator blades (5) which can also be constructed of light weight materials such as those described above. Wind with a downward diagonal thrust can be accommodated by the rotor blades (2) through use of an open stator cage cover (10) that renders the turbine (8) at least partially topless and increases efficiency by up to an estimated 20% over any prior art. Wind attempting to enter the turbine (8) against the prevailing wind direction and hence against the direction of the rotors is deflected by top shield (6). Top shield (6) has a central pivoting point and an outer terminus and moves about the open top of turbine (8) by use of a center bearing (10A) side bearings (10B) and bearing race (10C). The movement of the top shield (6) to a downwind position is aided by the top shield vane (7). Figure 1B depicts a second embodiment of the present invention wherein top shield (6) is not provided with a vane. The top shield (6) creates an area on the downwind side of the turbine (8) that is of low turbidity and increases the invention's ability to exhaust wind passing through the machine. The top shield (6) does not at any time hinder the accommodation of productive winds from any direction. Wherever feasible, the described elements are made using light materials as hereinbefore described.

[0023] Figure 2 and 2A show the rotor cage. Total rigidity and structural integrity may be enhanced by the top rotor cage plate (3) and the bottom rotor cage plate

(4).

[0024] Please note that the top plate (3) may be arced slightly to better compress and direct air or other fluid into the rotor cage. A reverse angle on the bottom rotor cage plate (4) may accomplish the same task but with an upward thrust.

[0025] Only the top and bottom rotor cage plates may be attached to the shaft. This unique aspect can aid in the invention's ability to readily accept, utilize and exhaust wind or other fluid. Structural integrity and rigidity may be enhanced by the rotor blades being attached in two places rather than directly to the shaft as in previous art.

[0026] Figure 3 shows the layout of the rotor blades (2) with respect to each other as well as to the shaft (1). Special note should be taken of the space (33) between the shaft (1) and the inside edge of the rotor blades (2). This space is a substantial component of one embodiment of the invention in a number of ways. First, by allowing some of the air to flow through the center of the machine, the air impacts the blade on the downwind side of the invention adding to thrust and aiding in the exhaust cycle. The space between the shaft and rotor can also achieve greater torque by pushing the kinetic energy of the wind to be exerted further away from the center point (i.e., the shaft). The flat surfaces of the rotor blades allow wind to impart its force and be immediately deflected. A curved or cupped surface (as described in previous art) may allow air to collect in the curvature and cushion the force of subsequent winds. The layout of the rotor cage in the preferred embodiment is shown but it must be mentioned that changes may be made to the layout without departing from the broad aspect of the present invention.

[0027] The deflected air from the rotor blades is also able to find its way through the space between the shaft and the rotor blades to aid in the invention's ability to exhaust. The space between the rotor blades and the shaft in the preferred embodiment vary proportionately with the size of the unit built.

[0028] In Figure 4, 4A and 4B, the stator blades (5) are arranged around the circumference of the rotor cage in equidistant pairs. In the preferred embodiment 8 blades are shown but more or fewer blades could be used without substantially departing from the broad aspect of the present invention. Unlike previous art, which had curved stator blades it has been found that straight stators that are offset from the center point allows air to enter the turbine with less turbidity and thus more force. When an attempt is made to bend or change the direction of air currents (as previous art has done with curved stator blades), the force of the wind may be greatly diminished. Straight stators, while directing air into the invention, can have, a minimal effect on the loss of kinetic energy. Stator blade offset angles of from 30° to 60° by increments of 1° have been tested, and it has been found that the optimal angle of offset from the center point for the stator blades is 45°. Changing this angle by as much as 1° can seriously degrade the performance of the turbine. For

example, tests have shown that in a 17.9 m/s (40 mph) wind, angling the stator blades at 44° will produce 200 kW less power over a 24 hour period than stator blades angled at 45°. The wind turbine has been designed to accept all available winds regardless of their speed and thus has no need for a stator design that would dampen or lessen the force of the wind.

[0029] Figure 5 depicts the alignment of the stator cage cover. This is the part of the invention that allows the turbine to be virtually topless with regard to incoming currents of air. Once properly attached to the stator blades, the turbine is structurally sound and is ready to withstand, with regard to wind turbine embodiments, winds in excess of 44.7 m/s (100 m.p.h). Air currents approaching the rotor cage that have a slightly downward thrust pass through the open top (between the bearing races) and impact the rotor blades creating rotation. Previous art was able to accommodate wind currents that moved horizontally only, and thus, were able to accommodate only a portion of the wind that can be handled by the new invention.

[0030] The stator cage cover may be constructed concentric braces to ensure structural stability. On the top side of the concentric braces are bearing races to accommodate the top shield bearings.

[0031] Figures 6 and 7 show the top shield and top shield vane. The vane can be designed to create enough drag to rotate the top shield to a downwind position. Figure 1B depicts a second, alternative embodiment wherein the vane technique is not incorporated.

[0032] Once the shield is in proper position, wind with a downward thrust is also allowed to enter the wind turbine. (Modeling done to date shows that the open top embodiment increases performance by up to about 20%.) The top shield prevents conflicting winds from entering the invention from the downwind side that would interfere with rotation or exhausting. The space between the top shield and the rotor cage can create a space of calm air that may improve the invention's exhausting characteristics and that has a dampening feature. The front side or upwind or upcurrent side of the top shield is slightly convex on the horizontal plane and may prevent the top shield from buffeting during periods of high winds. The center bearing (10A) of the top shield (6) can allow the mechanism to pivot easily while wheels or bearings (10B) resting on the concentric bearing races (10C) may carry the weight of the top shield. The wind vane or tail of the top shield (7) can aid in the top shield's ability to move into a position opposing the wind and may enhance the shield's stability during operation.

[0033] In addition, the overall weight of the components can be an integral part of the invention. While mass (i.e., weight) can be used to dampen or deaden vibration, the new invention operates so smoothly that the lightweight carbon fiber materials used in its construction will not jeopardize structural integrity and will allow the turbine to be placed atop existing buildings or in environmentally sensitive areas or areas where large erection

equipment would have no access.

[0034] As can be easily understood from the foregoing, the basic concepts of the present invention may be embodied in a variety of ways within the scope of the appended claims. It involves the use of light weight materials in the construction of wind turbines and both the enhanced harnessing of kinetic energy techniques resulting from the use of light weight construction material as well as devices to accomplish the appropriate harnessing of energy. In this application, the harnessing techniques are disclosed as part of the results shown to be achieved by the various devices described, including turbine systems, and as steps which are inherent to utilization. They are simply the natural result of utilizing the devices as intended and described.

[0035] It should also be understood that a variety of changes may be made without departing from the scope of the invention within the scope of the appended claims.

Claims

1. An improved lightweight vertically rotating wind turbine (8), having enhanced conversion of wind kinetic energy into usable energy, comprising:

- a. a base with a bottom surface defining an area and a top surface defining an area wherein said area of said bottom surface is larger than said area of said top surface and wherein said top surface comprises an energy-transfer element (11) and wherein said base comprises an upward tapered base having an angle to smoothly direct wind currents;
- b. a vertically rotating shaft (1) with a top end and a bottom end wherein said bottom end is mechanically connected to said energy-transfer element (11);
- c. an energy-utilizing device (12) responsive to said shaft through said energy-transfer element (11) of the top surface of said base;
- d. a top plate (3) attached to said vertically rotating shaft (1);
- e. a bottom plate (4) that defines a diameter and is attached to said vertically rotating shaft (1);
- f. a plurality of vertically oriented flat torque generating elements (2) having outer edges and inner edges which are localized circumferentially around said vertically rotating shaft (1) at a space between said top plate (3) and said bottom plate (4) and are attached therein to said top plate (3) and said bottom plate (4) at their ends to form a cage assembly;
- g. a plurality of vertically oriented flat wind directing elements (5) arranged circumferentially around said cage assembly and adjacent to said outer edges of said vertically oriented flat torque generating elements (2);

- h. an open cover (10) comprising concentric braces; and
- i. a top shield (6) having a central pivoting point with an outer terminus above said concentric braces above said open cover (10),

the improvement wherein the torque generating and wind directing elements (2, 5) of the wind turbine are constructed from lightweight materials which allow the enhanced conversion of wind kinetic energy into mechanical energy by the wind turbine (8), wherein said lightweight materials comprise sandwich panels comprising at least two outer face layers (22) and a honeycomb core (20,21) connecting them, such that the cells of the honeycomb core (20,21) extend substantially perpendicular to the face layers (22).

2. The improved vertically rotating wind turbine (8) as defined in Claim 1, wherein the lightweight material is a non-metallic material.
3. The improved vertically rotating wind turbine (8) as defined in Claim 1 wherein said top shield (6) further comprises a shield of exhausting wind against counter-prevailing wind currents.
4. The improved vertically rotating wind turbine (8) as defined in Claim 1 further comprising a top shield vane (7) wherein said top shield (6) is responsive to said top shield vane (7).
5. The improved vertically rotating wind turbine (8) as defined in Claim 1, wherein said flat wind directing elements (5) are each offset by an angle of about 45° from a center point defined by the vertically rotating shaft (1).
6. The improved vertically rotating wind turbine (8) as defined in Claim 1 wherein said vertically rotating shaft (1) is responsive to said cage assembly and passively rotates.
7. The improved vertically rotating wind turbine (8) as defined in Claim 1 wherein each of said plurality of vertically oriented torque generating elements (2) is solely attached to a round top plate (3) and a round bottom plate (4) at its ends to form said cage assembly.
8. The improved vertically rotating wind turbine (8) as defined in Claim 7 wherein each of said torque generating elements (2) has at least three differently oriented surfaces.
9. The improved vertically rotating wind turbine (8) as defined in Claim 1 wherein said flat wind directing elements (5) are attached to said base in equidistance pairs.

10. The improved vertically rotating wind turbine (8) as defined in Claim 1 wherein said open cover (10) comprises an open stator cage cover.
11. The improved vertically rotating wind turbine (8) as defined in Claim 10 wherein said open stator cage cover comprises concentric bearing races that have a center bearing and two circular side bearings. 5
12. The improved vertically rotating wind turbine (8) as defined in Claim 1 wherein said wind turbine (8) comprises a long axis vertical turbine that is an omniscient turbine. 10
13. The improved vertically rotating wind turbine (8) as defined in Claim 1, wherein the honeycomb core is manufactured from non-metallic carbon fibres or aluminium. 15
14. The improved vertically rotating wind turbine (8) as defined in Claim 1 wherein the top shield (6) is a dampening top shield above said open cover (10) having a central pivoting point and a convex front side surface with an outer terminus above said concentric braces above said open cover (10). 20 25
15. An improved lightweight vertically rotating wind turbine (8) according to Claim 1, having enhanced conversion of wind kinetic energy into usable energy, **characterised in that** 30
- a. said top plate (3) is round and is attached in the vicinity of the top end of said vertically rotating shaft;
6. said bottom plate (4) is round and is attached to said vertically rotating shaft (1) at a location above the top surface of said base; 35
- c. and said open cover (10) comprising concentric braces comprising two side bearings. 40

Patentansprüche

1. Verbesserte, leichte, um eine vertikale Achse rotierende Windturbine (8), die eine verbesserte Umwandlung von kinetischer Windenergie in nutzbare Energie ermöglicht und folgendes umfasst: 45
- a. eine Basis mit einer Bodenoberfläche, die einen Bereich definiert, und einer oberen Oberfläche, die einen Bereich definiert, wobei der Bereich der Bodenoberfläche größer ist als der Bereich der oberen Oberfläche und wobei die obere Oberfläche ein Energie-Übertragungselement (11) und die Basis eine nach oben verjüngte Basis aufweist, die einen Winkel besitzt, um Windströmungen glatt zu lenken, 50
- b. eine vertikale, rotierende Welle (1) mit einem

oberen Ende und einem unteren Ende, wobei das untere Ende mechanisch mit dem Energie-Übertragungselement (11) verbunden ist,

c. eine Energie-Nutzungseinrichtung (12), die mit der Welle durch das Energie-Übertragungselement (11) der oberen Oberfläche der Basis arbeitsmäßig verbunden ist,

d. eine obere Platte (3), die an der vertikalen, rotierenden Welle (1) befestigt ist,

e. eine Bodenplatte (4), die einen Durchmesser aufweist und an der vertikalen, rotierenden Welle (1) befestigt ist,

f. eine Vielzahl von vertikal gerichteten, flachen Drehmoment-Erzeugungselementen (2), die äußere und innere Ränder besitzen, die um die vertikale, rotierende Welle (1) herum umfänglich in einem Raum zwischen der oberen Platte (3) und der unteren Platte (4) angeordnet und in diesem mit ihren Enden an der oberen Platte (3) und der Bodenplatte (4) befestigt sind, um eine Käfig-Baueinheit zu bilden,

g. eine Vielzahl von vertikal gerichteten, flachen Wind-Lenkelementen (5), die die Käfig-Baueinheit umfänglich herum und in der Nähe der äußeren Ränder der vertikal gerichteten, flachen Drehmoment-Erzeugungselemente (2) angeordnet sind,

h. eine offene Abdeckung (10), die konzentrische Streben aufweist, und

i. einen Oberseiten-Schild (6), der einen zentralen Schwenkpunkt mit einem äußeren Kopf über den konzentrischen Streben über der offenen Abdeckung (10) aufweist,

wobei die Verbesserung darin besteht, dass die Drehmoment erzeugenden und den Wind lenkenden Elemente (2, 5) der Windturbine aus leichten Materialien hergestellt sind, wodurch eine erhöhte Umwandlung von kinetischer Windenergie in mechanische Energie durch die Windturbine (8) ermöglicht wird, und dass die leichten Materialien Sandwich-Paneele mit wenigstens zwei Außenflächen-Schichten (22) und einen Bienenwaben-Kern (20, 21) umfassen, der sie miteinander so verbindet, dass sich die Zellen des Bienenwaben-Kerns (20, 21) im wesentlichen senkrecht zu den Außenflächen-Schichten (22) erstrecken.

2. Verbesserte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 1, bei der das leichte Material ein nicht-metallisches Material ist.
3. Verbesserte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 1, bei der der Oberseiten-Schild (6) weiterhin eine Abschirmung für austretenden Wind gegen Windströmungen umfasst, die der vorherrschenden Windrichtung entgegengerichtet sind.

4. Verbesserte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 1, die weiterhin einen Oberseitenschild-Flügel (7) umfasst, wobei der Oberseitenschild (6) mit dem Oberseitenschild-Flügel (7) arbeitsmäßig verbunden ist. 5
5. Verbesserte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 1, bei der die flachen Windleit-Elemente (5) jeweils um einen Winkel von ungefähr 45° von einem Zentralpunkt versetzt sind, der durch die vertikale rotierende Welle (1) definiert ist. 10
6. Verbesserte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 1, bei der die vertikale, rotierende Welle (1) betriebsmäßig mit der Käfig-Baueinheit verbunden ist und sich passiv dreht. 15
7. Verbesserte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 1, bei der jedes der Vielzahl von vertikal gerichteten Drehmomenterzeugungselementen (2) lediglich mit seinen Enden an einer runden oberen Platte (3) und an einer runden Bodenplatte (4) befestigt ist, um die Käfig-Baueinheit zu bilden. 20 25
8. Verbesserte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 7, bei der jedes der Drehmoment erzeugenden Elemente (2) wenigstens drei unterschiedlich gerichtete Oberflächen aufweist. 30
9. Verbesserte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 1, bei der die flachen Windleit-Elemente (5) an der Basis in äquidistanten Paaren befestigt sind. 35
10. Verbesserte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 1, bei der die offene Abdeckung (10) eine offene Stator-Käfig-Abdeckung umfasst. 40
11. Verbesserte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 10, bei der die offene Stator-Käfig-Abdeckung konzentrische Laufringe umfasst, die ein zentrales Lager und zwei kreisförmige Seitenlager bilden. 45
12. Verbesserte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 1, wobei diese Windturbine (8) eine vertikale Turbine mit langer Achse umfasst, die eine Allstrom-Turbine ist. 50
13. Verbesserte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 1, bei der der Bienenwaben-Kern aus nicht-metallischen Kohlenstoff-Fasern oder Aluminium hergestellt ist. 55

14. Verbesserte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 1, bei der der Oberseiten-Schild (6) ein Dämpfungs-Oberseiten-Schild über der offenen Abdeckung (10) ist, der einen zentralen Schwenkpunkt und eine konvexe Vorderseiten-Oberfläche mit einem äußeren Kopf über den konzentrischen Streben über der offenen Abdeckung (10) umfasst.

15. Verbesserte, leichte, um eine vertikale Achse rotierende Windturbine (8) nach Anspruch 1, die eine erhöhte Umwandlungsfähigkeit von kinetischer Windenergie in Nutzenergie aufweist, **dadurch gekennzeichnet, dass**

- a. die Oberseitenplatte (3) rund und in der Nachbarschaft des oberen Endes der vertikalen, rotierenden Welle befestigt ist, dass
- b. die Bodenplatte (4) rund und an der vertikalen, rotierenden Welle (1) an einer Stelle oberhalb der oberen Oberfläche der Basis befestigt ist und,
- c. dass die Abdeckung (10) konzentrische Streben umfasst, die zwei Seitenlager aufweisen.

Revendications

1. Turbine éolienne légère tournant verticalement améliorée (8) présentant une conversion améliorée de l'énergie cinétique du vent en énergie utilisable, comprenant:
 - a. une base ayant une surface inférieure définissant une zone et une surface supérieure définissant une zone, dans laquelle ladite zone de ladite surface inférieure est supérieure à ladite zone de ladite surface supérieure et dans laquelle ladite surface supérieure comprend un élément de transfert d'énergie (11) et dans laquelle ladite base comprend une base conique ayant un angle permettant de diriger les courants de vent en douceur ;
 - b. un arbre tournant verticalement (1) avec une extrémité supérieure et une extrémité inférieure, dans lesquelles ladite extrémité inférieure est mécaniquement connectée audit élément de transfert d'énergie (11) ;
 - c. un dispositif utilisant de l'énergie (12) sensible audit arbre à travers ledit élément de transfert (11) de la surface supérieure de ladite base ;
 - d. une plaque supérieure (3) fixée audit arbre tournant verticalement (1) ;
 - e. une plaque inférieure (4) qui définit un diamètre et est fixée audit arbre tournant verticalement (1) ;
 - f. une pluralité d'éléments générateurs de couple orientés verticalement (2), ayant des

bords extérieurs et des bords intérieurs qui sont localisés circonférentiellement autour dudit arbre tournant verticalement (1) au niveau d'un espace entre ladite plaque supérieure (3) et ladite plaque inférieure (4) et sont fixés à l'intérieur de ladite plaque supérieure (3) et de ladite plaque inférieure (4) à leurs extrémités pour former un ensemble de cage ;

g. une pluralité d'éléments directeurs de vent plats orientés verticalement (5) disposés circonférentiellement autour dudit ensemble de cage et adjacents auxdits bords extérieurs desdits éléments de génération de couple plats orientés verticalement (2) ;

h. une couverture ouverte (10) comprenant des entretoisements concentriques ; et

i. un bouclier supérieur (6) ayant un point pivotant central avec un terminal extérieur au dessus desdits entretoisements concentriques au-dessus dudit couvercle ouvert (10),

amélioration dans laquelle les éléments générateurs de couple et directeurs de vent (2, 5) de la turbine éolienne sont réalisés à partir de matériaux légers qui permettent une conversion améliorée de l'énergie cinétique du vent en énergie mécanique par la turbine éolienne (8), dans laquelle lesdits matériaux légers comprennent des panneaux sandwich comprenant au moins deux couches de face extérieure (22) et un coeur en nid d'abeille (20, 21) qui les relie, de sorte que les cellules du coeur en nid d'abeille (20, 21) s'étendent sensiblement perpendiculairement aux couches de face (22).

2. Turbine éolienne tournant verticalement améliorée (8), comme défini dans la revendication 1, dans laquelle le matériau léger est un matériau non-métallique.

3. Turbine éolienne tournant verticalement améliorée (8), comme défini dans la revendication 1, dans laquelle ledit bouclier supérieur (6) comprend en outre un bouclier aspirant éolien contre les courants de vent contre-dominants.

4. Turbine éolienne tournant verticalement améliorée (8), comme défini dans la revendication 1, comprenant en outre une aube de bouclier supérieur (7) dans laquelle ledit bouclier supérieur (6) est sensible à ladite aube de bouclier supérieur (7).

5. Turbine éolienne tournant verticalement améliorée (8), comme défini dans la revendication 1, dans laquelle lesdits éléments de direction du vent plats (5) sont chacun décalés d'un angle d'environ 45° par rapport à un point central défini par l'arbre tournant verticalement (1).

6. Turbine éolienne tournant verticalement améliorée (8), comme défini dans la revendication 1, dans laquelle ledit arbre tournant verticalement (1) est sensible audit ensemble de cage et tourne passivement.

7. Turbine éolienne tournant verticalement améliorée (8), comme défini dans la revendication 1, dans laquelle chacune desdites pluralités d'éléments de génération de couple orientés verticalement (2) est seulement fixée à une plaque supérieure ronde (3) et une plaque inférieure ronde (4) à ses extrémités pour former ledit ensemble de cage.

8. Turbine éolienne tournant verticalement améliorée (8), comme défini dans la revendication 7, dans laquelle chacun des éléments de génération de couple (2) a au moins trois surfaces orientées différemment.

9. Turbine éolienne tournant verticalement améliorée (8), comme défini dans la revendication 1, dans laquelle lesdits éléments de direction du vent plats (5) sont fixés à ladite base par paires équidistantes.

10. Turbine éolienne tournant verticalement améliorée (8), comme défini dans la revendication 1, dans laquelle ledit couvercle ouvert (10) comprend un couvercle de cage de stator ouvert.

11. Turbine éolienne tournant verticalement améliorée (8), comme défini dans la revendication 10, dans laquelle ledit couvercle de cage de stator ouvert comprend des voies de roulements concentriques qui ont un roulement central et deux roulements latéraux circulaires.

12. Turbine éolienne tournant verticalement améliorée (8), comme défini dans la revendication 1, dans laquelle ladite turbine éolienne (8) comprend une turbine verticale à axe long qui est une turbine omniscourant.

13. Turbine éolienne tournant verticalement améliorée (8), comme défini dans la revendication 1, dans laquelle le coeur en nid d'abeille est fabriqué à partir de fibres de carbone non métalliques ou d'aluminium.

14. Turbine éolienne tournant verticalement améliorée (8), comme défini dans la revendication 1, dans laquelle le bouclier supérieur (6) est un bouclier supérieur d'amortissement au dessus dudit couvercle ouvert (10) ayant un point de pivot central et une surface latérale avant convexe avec un terminal extérieur au dessus desdits entretoisements concentriques au dessus dudit couvercle ouvert (10).

15. Turbine éolienne légère tournant verticalement améliorée (8), selon la revendication 1, ayant une con-

version améliorée d'énergie cinétique du vent en une énergie utilisable, **caractérisée en ce que**

- a. ladite plaque supérieure (3) est ronde et est fixée à proximité de l'extrémité supérieure dudit arbre tournant verticalement ; 5
- b. ladite plaque inférieure (4) est ronde et est fixée audit arbre tournant verticalement (1) à un emplacement au dessus de la surface supérieure de ladite base ; 10
- c. et ledit couvercle ouvert (10) comprenant des entretoisements concentriques comprenant deux roulements latéraux. 15

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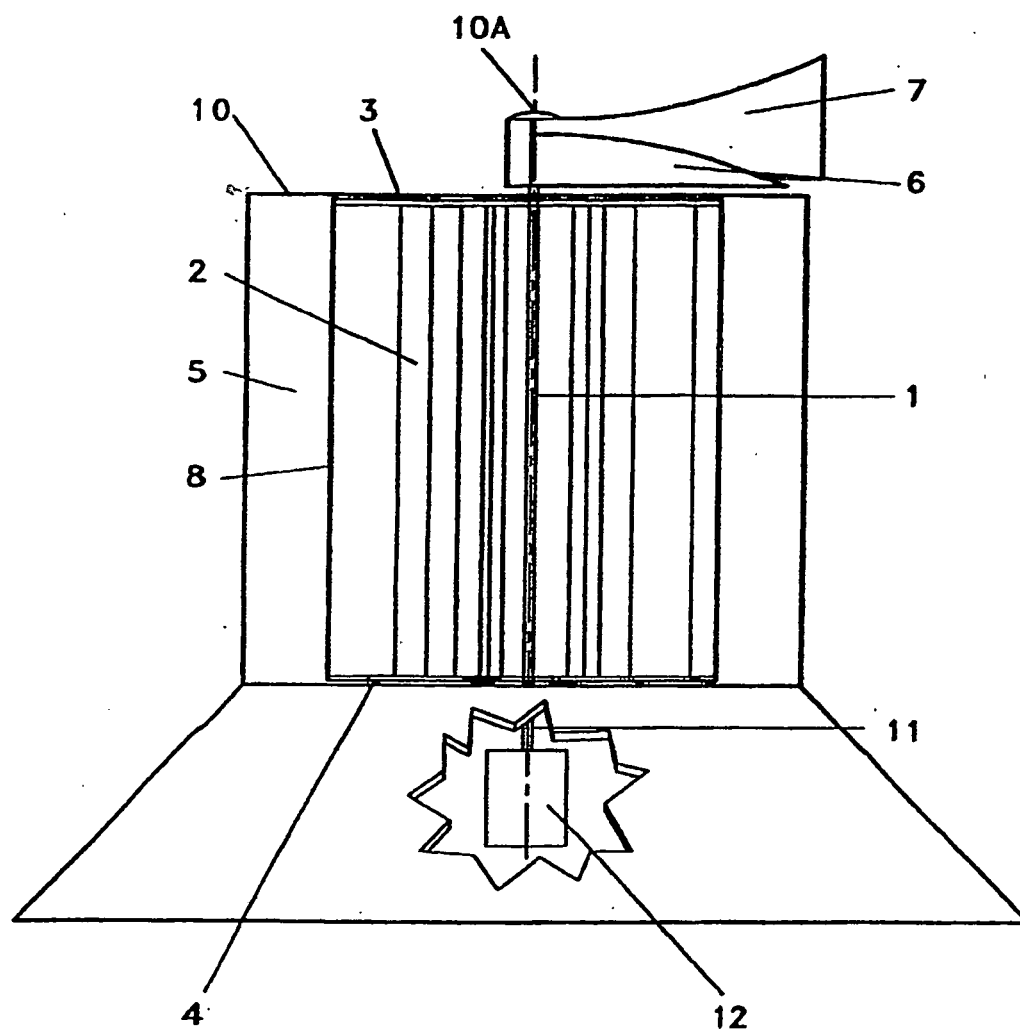


Fig. 1

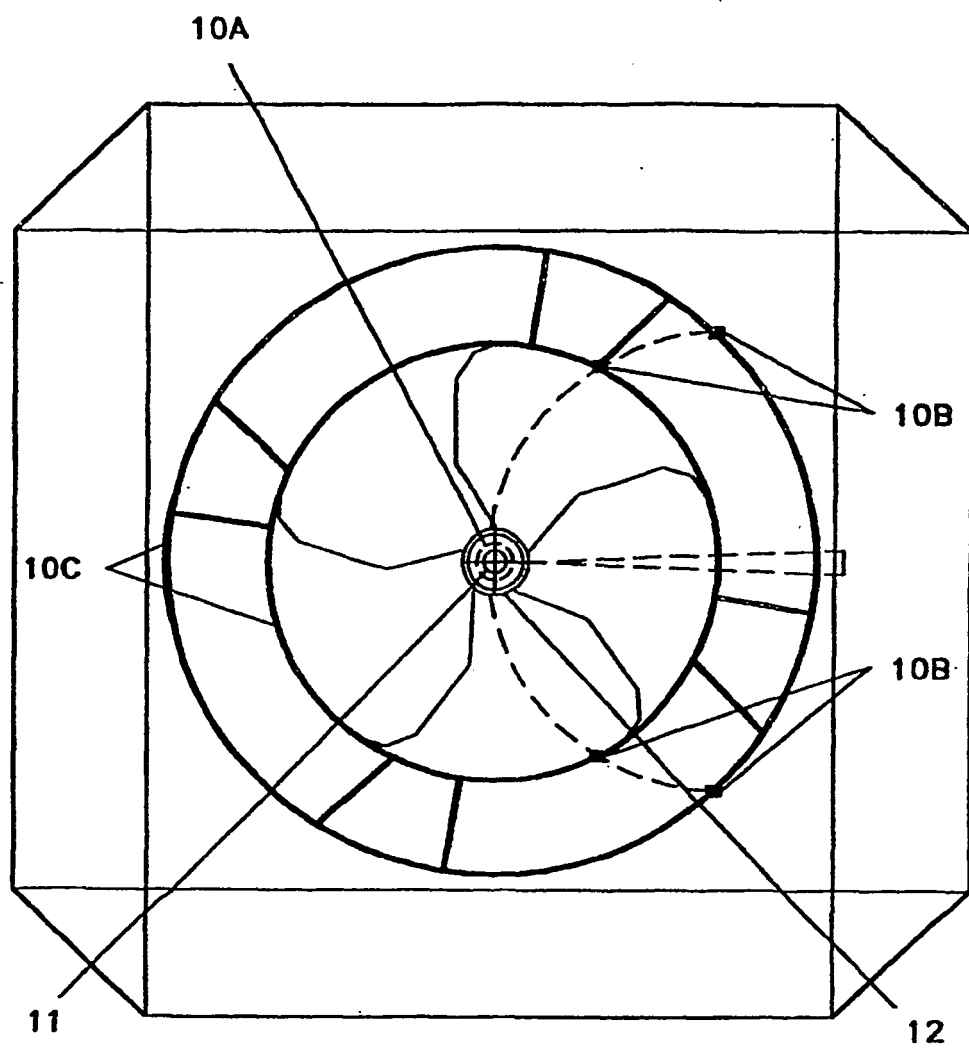


Fig. 1A

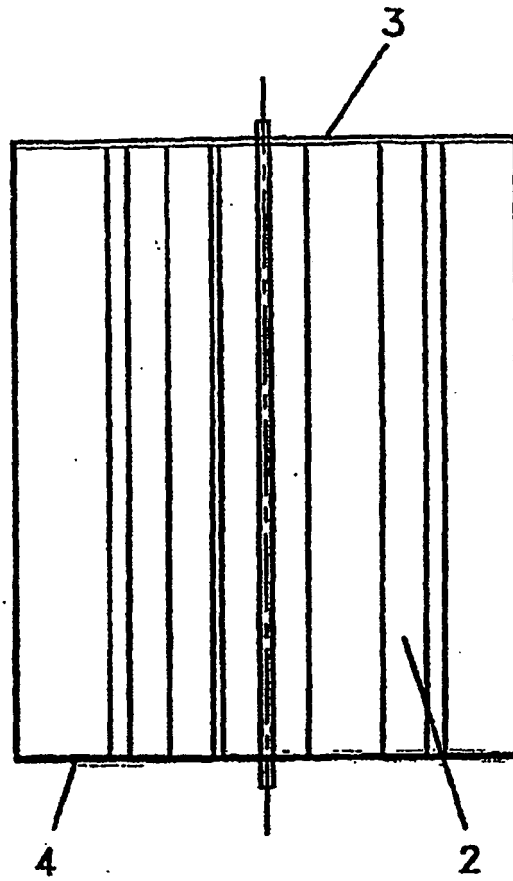


Fig. 2

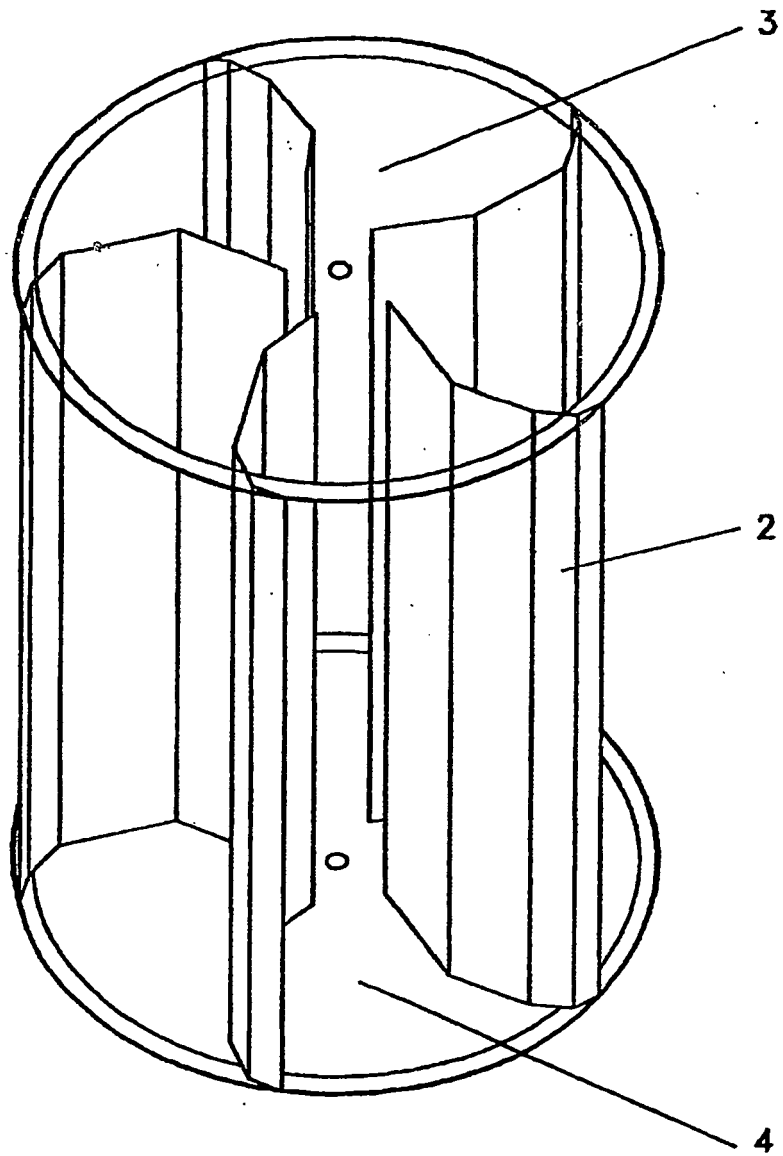


Fig. 2A

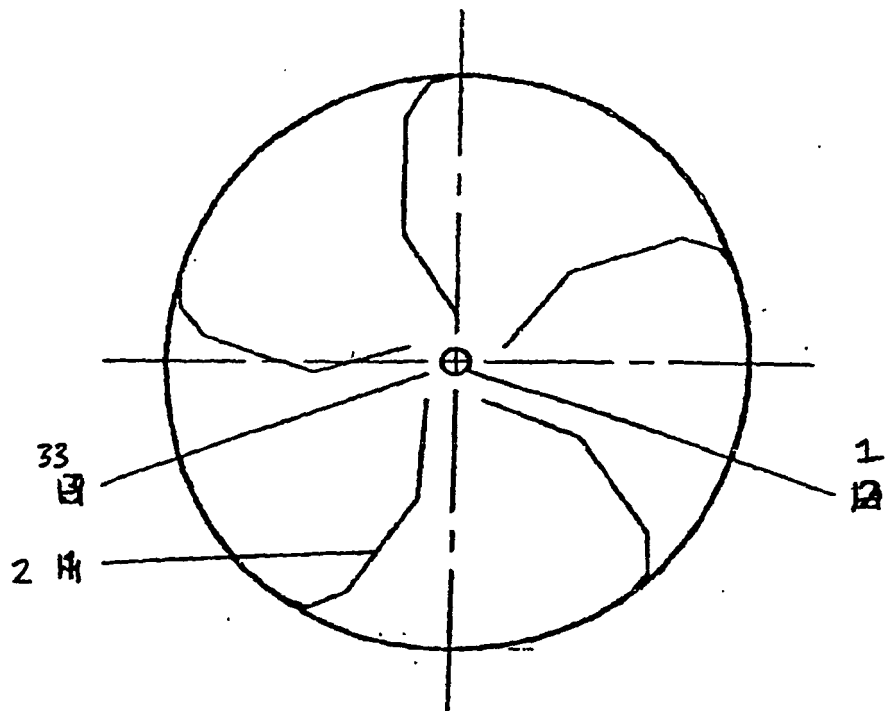


Fig. 3

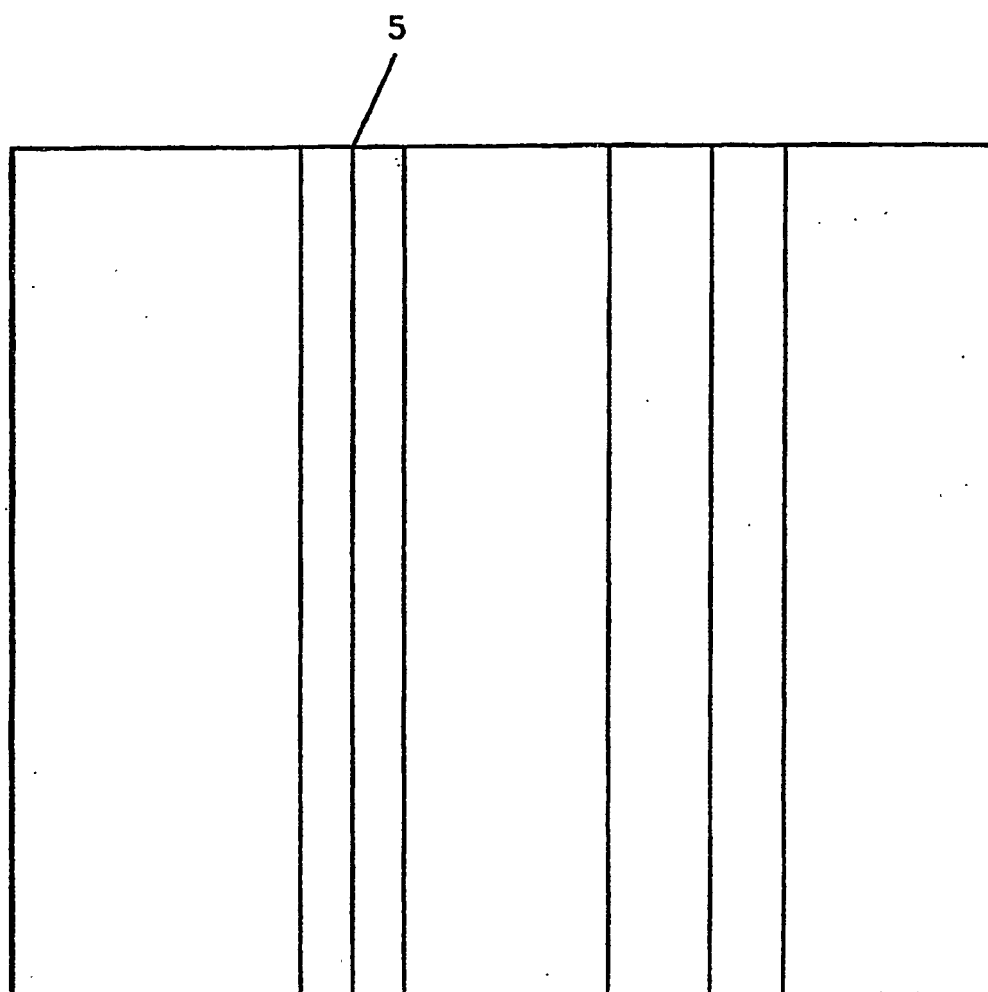


Fig. 4

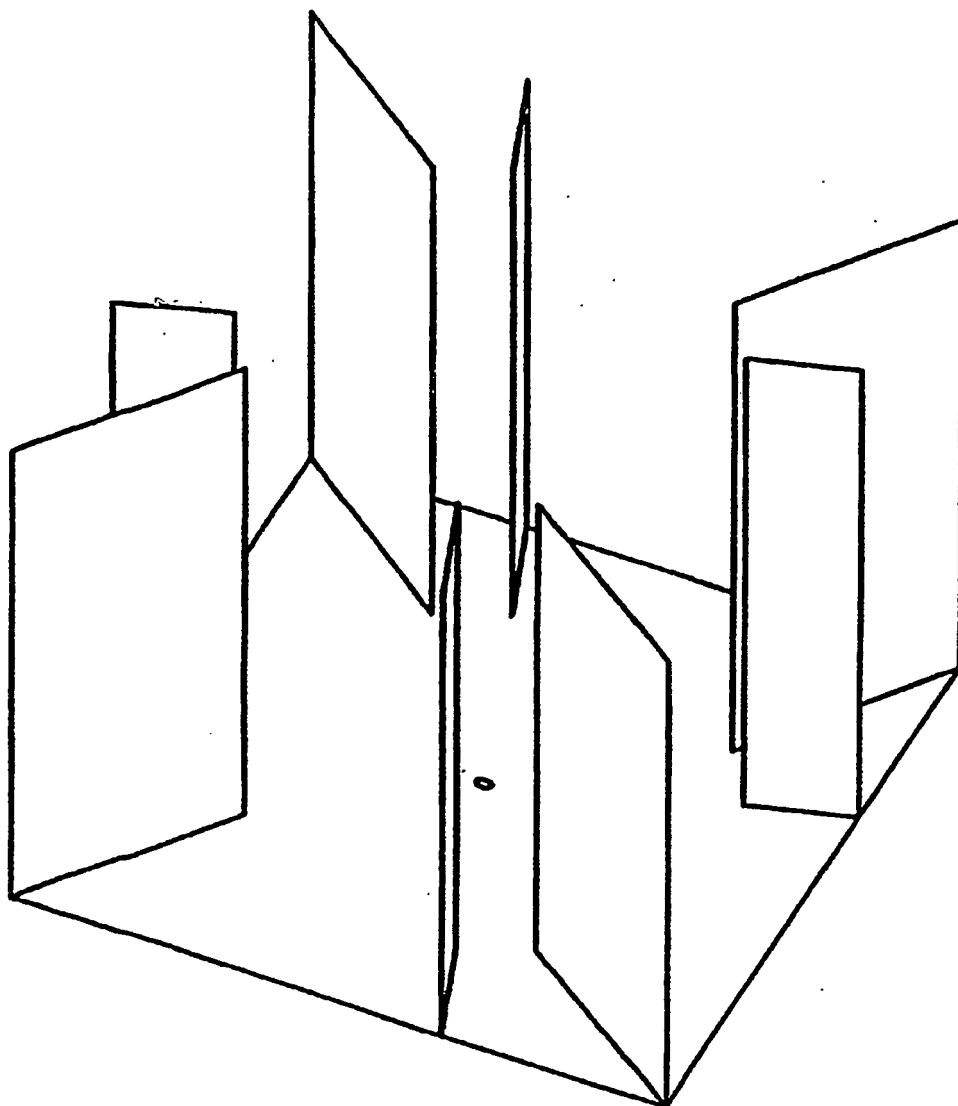


Fig. 4A

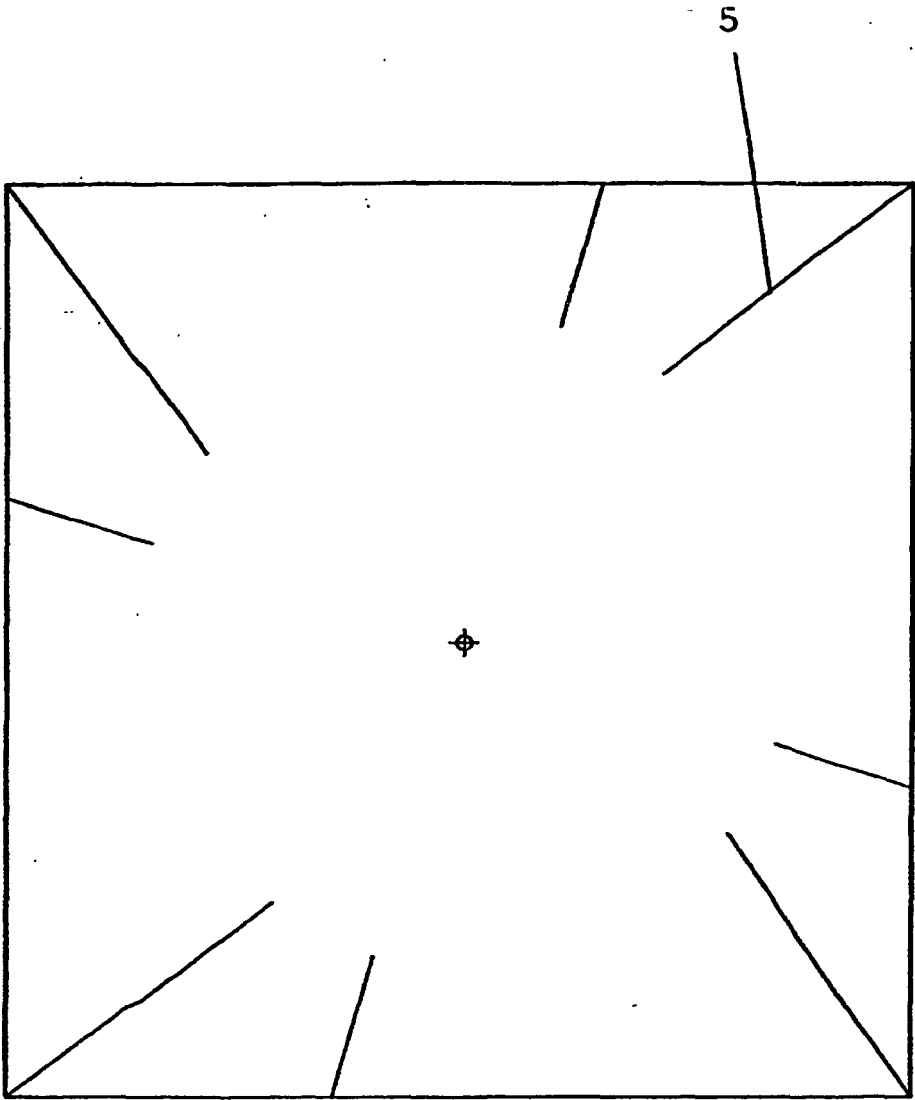


Fig. 4B

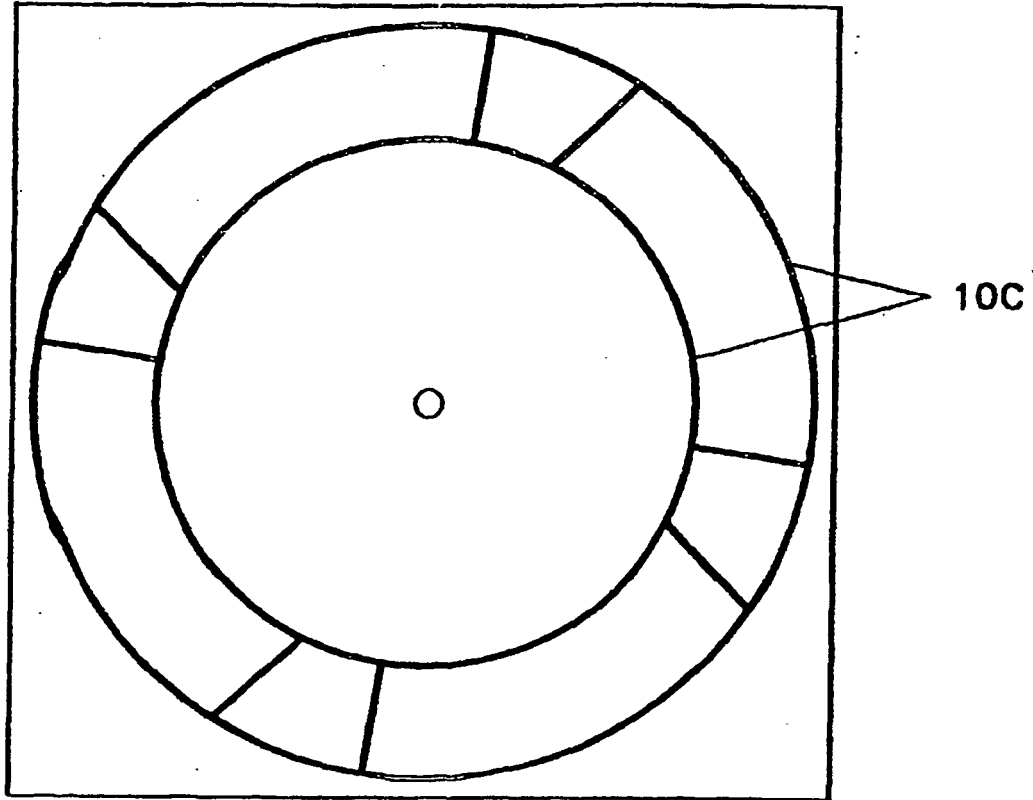


Fig. 5

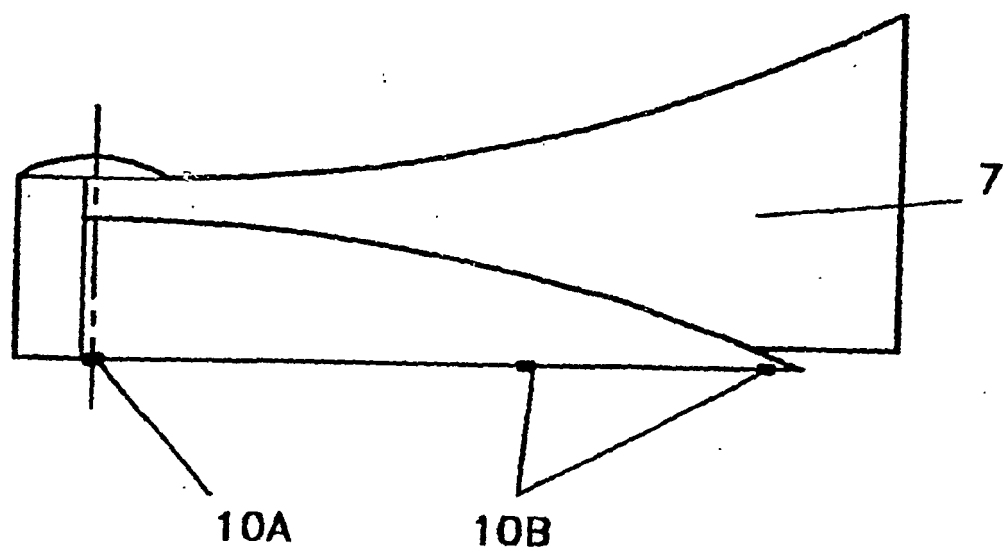


Fig. 6

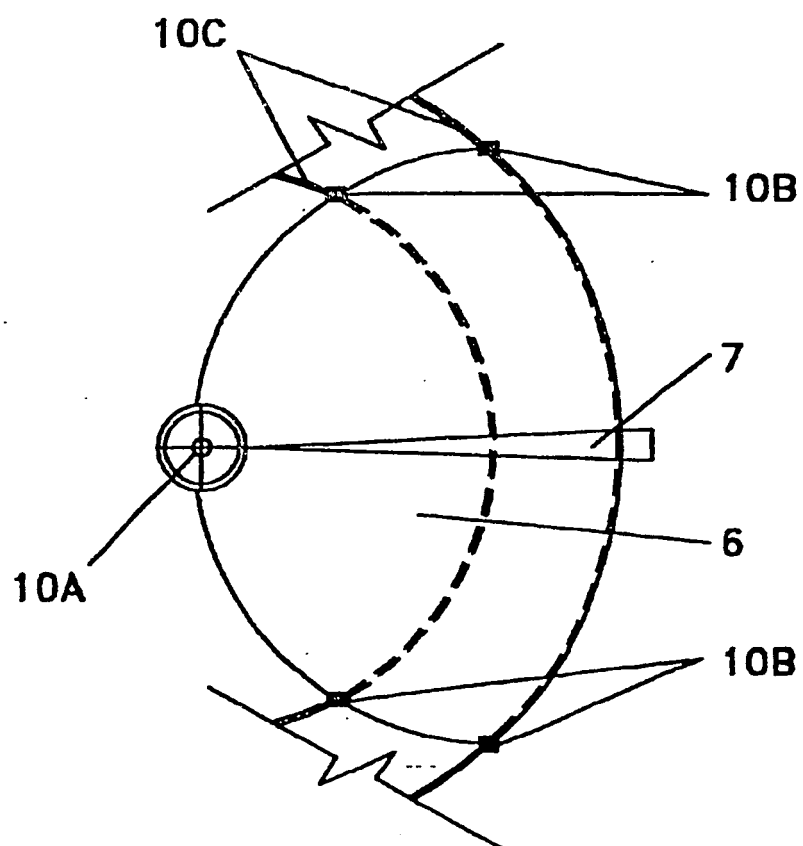


Fig. 7

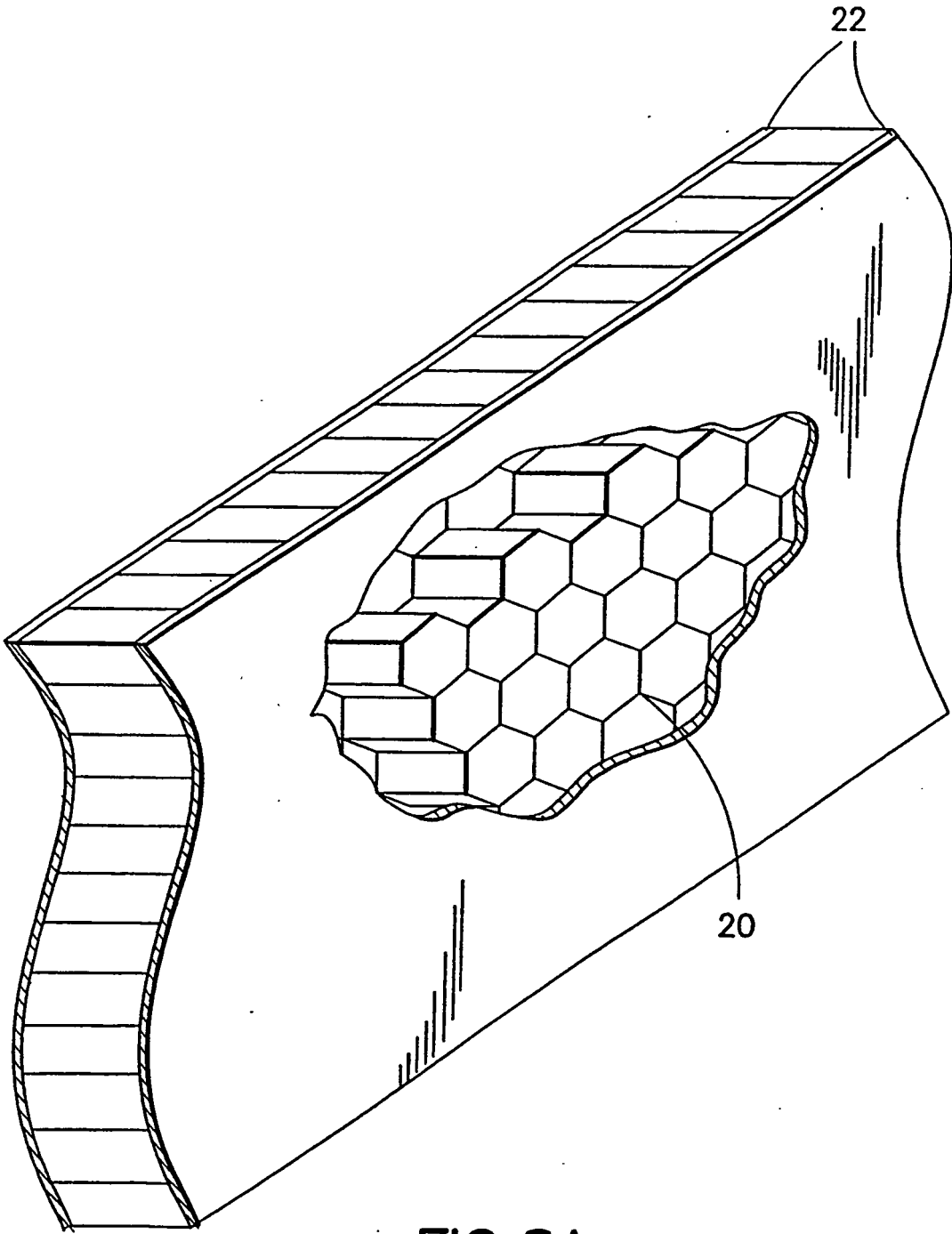


FIG.8A

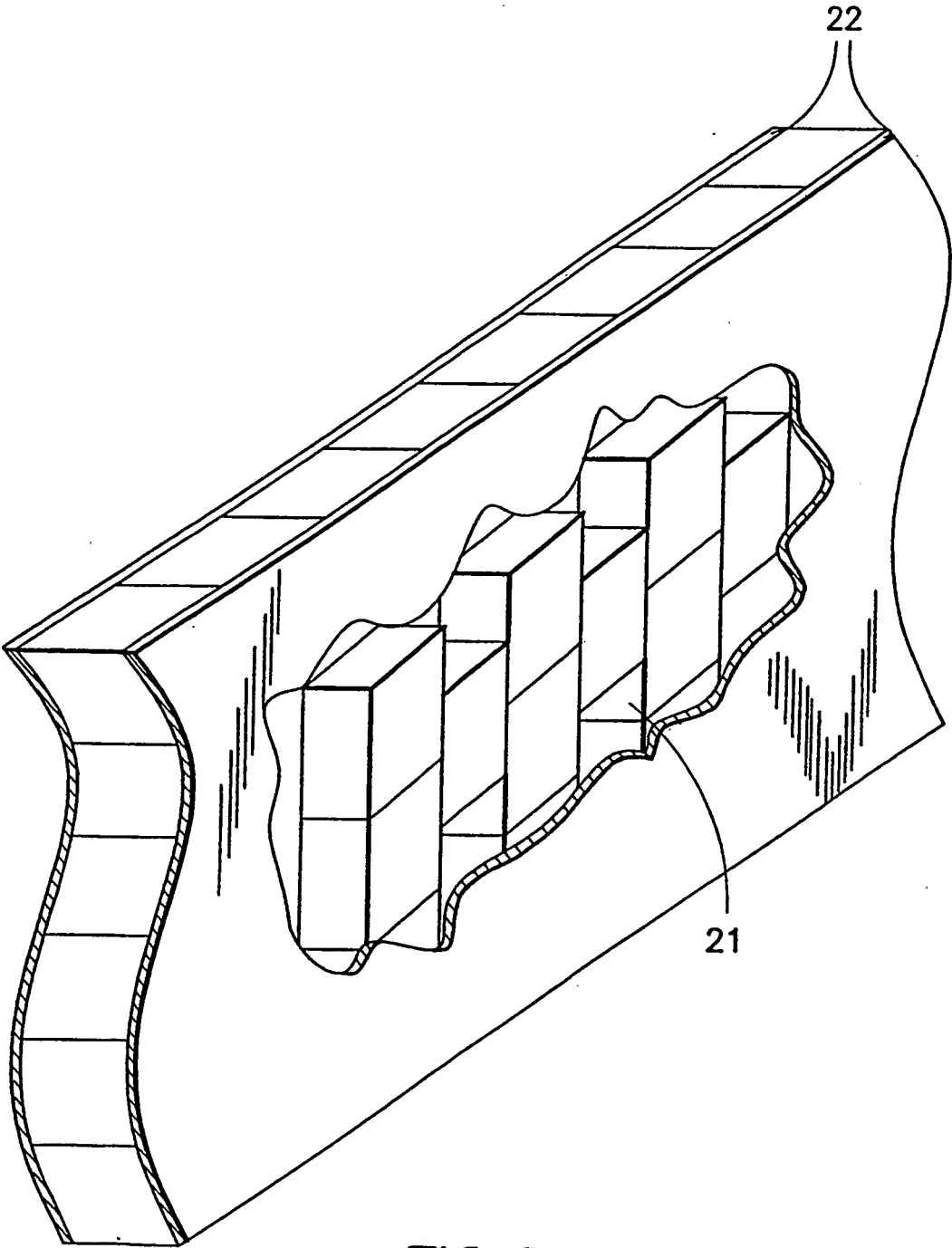


FIG.8B